Port of Houston/Galveston, Texas, After Action Report

INTRODUCTION

A Port Risk Assessment was conducted for the port of Houston/Galveston, Texas 25 – 26 January 2000. This report will provide the following information:

- Brief description of the process used for the assessment;
- List of participants;
- Numerical results from the Analytical Hierarchy Process (AHP); and
- Summary of risks and mitigations discussion.

Follow-on strategies to develop and implement unmitigated risks will be the subject of a separate report.

PROCESS.

The risk assessment process is a disciplined approach to obtaining expert judgements on the level of waterway risk. The process also addresses the relative merit of specific types of Vessel Traffic Management (VTM) improvements for reducing risk in the port. Based on the Analytic Hierarchy Process (AHP)[1], the port risk assessment process involves convening a select group of expert/stakeholders in each port and conducting structured workshops to evaluate waterway risk factors and the effectiveness of various VTM improvements. The process requires the participation of local Coast Guard officials before and throughout the workshops. Identification of local risk factors/drivers and selecting appropriate risk mitigation measures is thus accomplished by a joint effort involving experts and stakeholders, including both waterway users and the agencies/entities responsible for implementing selected risk mitigation measures.

This methodology hinges on the development of a generic model of vessel casualty risk in a port. Since risk is defined as the product of the probability of a casualty and its consequences, the model includes variables associated with both the causes and the effects of vessel casualties. The model uses expert opinion to weight the relative contribution of each variable to the overall port risk. The experts are then asked to establish scales to measure each variable. Once the parameters have been established for each risk-inducing factor, the port's risk is estimated by inputting values for the variables specific to that port into the risk model. The model also produces an index of relative merit for five VTM levels as perceived by the local experts assembled for each port.

[1] Developed by Dr Thomas L. Saaty, et al to structure complex decision making, to provide scaled measurements, and to synthesize many factors having different dimensions.

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE **JAN 2000**	2. REPORT TYPE	3. DATES COVERED **00-00-2000 to 00-00-2000**

4. TITLE AND SUBTITLE **Port Risk Assessment Port of Houston/Galveston, Texas, After Action Report**	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Coast Guard Academy ,31 Mohegan Avenue ,New London ,CT,06320-8103**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**17**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

PARTICIPANTS.

The following is a list of stakeholders/experts that participated in the process:

Alisha Goldberg	Galveston Bay Foundation	Gbf@electrotex.com
Alistar MacNab	Marine Exchange of the West Gulf, Inc.	
Alton Landry	Marine Exchange of the West Gulf, Inc.	Alandry@swbell.net
Bing Hastings Div. CAPT	USCG Auxiliary	Binghastings@worldnet.att.net
Danny J. Wyatt	USACOE	danny.j.wyatt@usace.army.mil
David Edelson	R. B. Falcon	Dedelson@rbfalcon.com
Gene Schwantes	Texas Mariners Cruising Assoc.	102102.205@compuserve.com
Jack Lane	Galveston-Texas City Pilots	
Joe Lindsey	Galveston Ferries	Jbldll@aol.com
John Basilotto	Center for Ports and Waterways	J-Basilotto@tamu.edu
John Rozsypal	U. S. Army Corps of Engineers, Galv District	johnny.rozsypal@swg02.usace.army.mil
John Salvesen	Clean Channel	mail@Houston.odfjell-tankers.com
John Savage, Captain	G & H Towing	Jsavage@wt.net
Kevin Cook, CDR, USCG	USCG MSO Houston/Galveston	xo/msohougalv@internet.uscg.mil
Larry Miller	Port of Houston Authority	Lmiller@poha.com
L. Roy Murray, Captain	Houston Pilots Assoc.	Lmurray@poho.com
Marvin Reed, Captain	Texas Waterways Operators Assoc.	mr@cotowco.com
Mike Morris, Captain	Houston Pilots Assoc.	lmiller@poho.com
Peter Simons, CDR, USCG	USCG VTS Houston /Galveston	Psimons@vtsHouston.uscg.mil
Rick Deel	The LUBRIZOL Corp.	rwde@lubrizol.com
Richard L. Moore	PISCES	
Ted Thorjussen	West Gulf Marine	Thorjussen@wgma.org
Thomas Horan, BMC, USCG	USCG Group Galveston	Thoran@grugalveston.uscg.mil
Thomas Munsell	Sea River Maritime, Inc.	Thomas.m.munsell@searivercom
Tim Hicks	USCG VTS Houston /Galveston	Thicks@vtsHouston.uscg.mil
Timothy Leitzell	Butterworth Global Marine Services	tleitzell@butterworthsystems.com
Tricia Clark	Skaugen Petro Trans, Inc.	Tricia.clark@skaugen.com
Wayne Gusman, CAPT, USCG	USCG MSO Houston/ Galveston	co/msohougalv@internet.uscg.mil

NUMERICAL RESULTS.

Book 1 - Factors *(Generic Weights sum to 100))*

Fleet Composition	Traffic Conditions	Navigational Conditions	Waterway Configuration	Short-term Consequences	Long-term Consequences
19.7	11.1	30.3	12.1	11.0	15.8

Analysis:
The participants contributed the above scores to the National Model. They determined that the Fleet Composition, Navigational Conditions, and Long term Consequences are the largest drivers of risk.

Book 2 - Risk Subfactors *(Generic Weights*)

Fleet Composition 19.7	Traffic Conditions 11.1	Navigational Conditions 30.3	Waterway Configuration 12.1	Short-term Consequences 11.0	Long-term Consequences 15.8
% High Risk Deep Draft 10.5	Volume Deep Draft 2.1	Wind Conditions 5.6	Visibility Obstructions 2.1	Volume of Passengers 4.5	Economic Impacts 3.2
% High Risk Shallow Draft 9.2	Volume Shallow Draft 2.2	Visibility Conditions 16.6	Passing Arrangements 1.3	Volume of Petroleum 2.0	Environmental Impacts 3.4
	Vol. Fishing & Pleasure Craft 2.4	Currents, Tides, Rivers 5.3	Channel and Bottom 2.6	Volume of Chemicals 4.5	Health & Safety Impacts 9.2
	Traffic Density 4.4	Ice Conditions 2.8	Waterway Complexity 6.1		

Analysis:
The participants contributed the above results to the national model. Subfactors contributing the most to overall risk under each of the six major factors were:

- For the Fleet Composition factor, High-Risk Deep Draft Vessels contribute about the same as much risk as Shallow Draft.
- For Traffic Conditions, Traffic Density contributes the greatest amount of risk to the waterway.
- For Navigational Conditions, Visibility Conditions contribute the most.
- For Waterway Configuration, Waterway Complexity contributes the most.
- For Short Term Consequences, The Volume of Chemicals and Volume of Passengers contributes the same.
- For Long Term Consequences, Health and Safety contribute the most.

Book 3 Subfactor Scales - Condition List (Generic)

	Scale Value
Wind Conditions	
a. Severe winds < 2 days / month	1.0
b. Severe winds occur in brief periods	2.5
c. Severe winds are frequent & anticipated	4.9
d. Severe winds occur without warning	9.0
Visibility Conditions	
a. Poor visibility < 2 days/month	1.0
b. Poor visibility occurs in brief periods	2.2
c. Poor visibility is frequent & anticipated	4.8
d. Poor visibility occurs without warning	9.0
Current, Tide or River Conditions	
a. Tides & currents are negligible	1.0
b. Currents run parallel to the channel	2.0
c. Transits are timed closely with tide	4.7
d. Currents cross channel/turns difficult	9.0
Ice Conditions	
a. Ice never forms	1.0
b. Some ice forms-icebreaking is rare	2.1
c. Icebreakers keep channel open	5.4
d. Vessels need icebreaker escorts	9.0
Visibility Obstructions	
a. No blind turns or intersections	1.0
b. Good geographic visibility-intersections	1.9
c. Visibility obscured, good communications	4.5
d. Distances & communications limited	9.0
Passing Arrangements	
a. Meetings & overtakings are easy	1.0
b. Passing arrangements needed-ample room	1.9
c. Meetings & overtakings in specific areas	5.8
d. Movements restricted to one-way traffic	9.0
Channel and Bottom	
a. Deep water or no channel necessary	1.0
b. Soft bottom, no obstructions	1.7
c. Mud, sand and rock outside channel	4.9
d. Hard or rocky bottom at channel edges	9.0
Waterway Complexity	
a. Straight run with NO crossing traffic	1.0
b. Multiple turns > 15 degrees-NO crossing	2.2
c. Converging - NO crossing traffic	4.6
d. Converging WITH crossing traffic	9.0

Passenger Volume	
a. Industrial, little recreational boating	1.0
b. Recreational boating and fishing	2.9
c. Cruise & excursion vessels-ferries	5.7
d. Extensive network of ferries, excursions	9.0
Petroleum Volume	
a. Little or no petroleum cargoes	1.0
b. Petroleum for local heating & use	2.0
c. Petroleum for transshipment inland	4.6
d. High volume petroleum & LNG/LPG	9.0
Chemical Volume	
a. Little or no hazardous chemicals	1.0
b. Some hazardous chemical cargo	2.0
c. Hazardous chemicals arrive daily	5.0
d. High volume of hazardous chemicals	9.0
Economic Impacts	
a. Vulnerable population is small	1.0
b. Vulnerable population is large	2.9
c. Vulnerable, dependent & small	5.9
d. Vulnerable, dependent & Large	9.0
Environmental Impacts	
a. Minimal environmental sensitivity	1.0
b. Sensitive, wetlands, VULNERABLE	2.5
c. Sensitive, wetlands, ENDANGERED	5.5
d. ENDANGERED species, fisheries	9.0
Safety and Health Impacts	
a. Small population around port	1.0
b. Medium - large population around port	3.1
c. Large population, bridges	5.5
d. Large DEPENDENT population	9.0

Analysis:

The participants contributed the above calibrations to the Subfactor scales for the national model. For each Subfactor above there is a low (Port Heaven) and a high (Port Hell) severity limit, which are assigned values of 1 and 9 respectively. The participants determined numerical values for two intermediate qualitative descriptions between those two extreme limits. In general, participants from this port evaluated the difference in risk between the lower limit (Port Heaven) and the first intermediate scale point as being equal to the difference in risk associated with the first and second intermediate scale points. The difference in risk between the second intermediate scale point and the upper risk limit (Port Hell) was generally 2.5 times as great.

Book 4 Risk Subfactor Ratings (Houston/Galveston)

Fleet Composition	**Traffic Conditions**	**Navigational Conditions**	**Waterway Configuration**	**Short-term Consequences**	**Long-term Consequences**
% High Risk Deep Draft 3.9	Volume Deep Draft 6.1	Wind Conditions 2.6	Visibility Obstructions 3.6	Volume of Passengers 6.3	Economic Impacts 8.7
% High Risk Shallow Draft 5.4	Volume Shallow Draft 6.8	Visibility Conditions 2.1	Passing Arrangements 5.3	Volume of Petroleum 8.4	Environmental Impacts 7.5
	Vol. Fishing & Pleasure Craft 5.6	Currents, Tides, Rivers 4.2	Channel and Bottom 3.5	Volume of Chemicals 8.7	Health & Safety Impacts 5.5
	Traffic Density 5.8	Ice Conditions 1.0	Waterway Complexity 9.0		

Analysis:

Based on the input from the participants, the following top risks occur in Houston/Galveston (in order of importance):

1. Waterway Complexity
2. Volume of Chemicals
3. Economic Impacts
4. Volume of Petroleum
5. Environmental Impacts

Book 5 (Houston/Galveston)

Subfactor	Book 4 Results	Book 5 Results Avg	Std Dev	RA	IER	INI	IAN	IEA	AIS	EAIS	VSC	VSI	Combined Results Delta	Rank	Tool	
% High Risk Deep Draft	3.9	2.9	0.92	4	4	0	2	0	1	2	1	0	1.0	15	RA	ALERT
% High Risk Shallow Draft	5.4	3.1	1.38	2	6	0	1	0	1	2	2	0	2.3	7	IER	ALERT
Volume Deep Draft	6.1	4.5	1.29	3	0	0	0	1	4	6	0	0	1.6	11	EAIS	
Volume Shallow Draft	6.8	4.7	1.07	0	2	0	2	1	2	5	2	0	2.1	8	EAIS	
Vol. Fishing & Pleasure Craft	5.6	3.7	1.38	1	11	0	0	0	0	0	2	0	1.9	9	IER	
Traffic Density	6.8	4.1	1.00	0	1	0	0	0	3	4	6	0	2.7	5	VTS	
Wind Conditions	2.6	2.5	0.65	10	0	2	0	0	0	1	1	0	0.1	18	RA	
Visibility Conditions	2.1	2.3	0.61	9	0	0	0	1	1	2	1	0	-0.2	19	RA	
Currents, Tides, Rivers	4.2	2.6	0.93	2	0	7	0	0	0	4	1	0	1.6	12	INI	
Ice Conditions	1.0	1.6	2.14	14	0	0	0	0	0	0	0	0	-0.6	20	RA	
Visibility Obstructions	3.6	2.8	1.05	3	0	0	8	0	1	0	2	0	0.8	16	IAN	
Passing Arrangements	5.3	3.6	1.01	2	4	0	1	1	2	1	3	0	1.7	10	IER	ALERT
Channel & Bottom	3.5	3.3	0.73	8	0	4	2	0	0	0	0	0	0.2	17	RA	
Waterway Complexity	9.0	5.5	1.40	0	2	0	0	0	1	6	4	1	3.5	1	EAIS	
Volume of Passengers	6.3	4.8	1.42	3	3	0	1	0	2	5	0	0	1.5	13	EAIS	
Volume of Petroleum	8.4	5.6	1.45	1	3	0	0	0	1	6	3	0	2.8	4	EAIS	
Volume of Chemicals	8.7	5.4	1.98	1	3	0	0	0	1	6	3	0	3.3	2	EAIS	
Economic Impacts	8.7	5.7	2.02	1	4	0	0	0	2	6	1	0	3.0	3	EAIS	
Environmental Impacts	7.5	5.1	1.90	1	5	0	0	0	1	5	2	0	2.4	6	IER	ALERT
Health & Safety Impacts	5.5	4.5	1.09	5	2	0	0	0	1	4	2	0	1.0	14	RA	ALERT

<u>Legend:</u>

If the acceptable risk level is <u>higher or equal</u> to the existing risk level for a particular subfactor, circle RA (Risk Acceptable) at the end of that line. Otherwise, circle the VTM tool that you feel would MOST APPROPRIATLY reduce the unmitigated risk to an acceptable level.

IER = Improve Existing Rules (pilotage rules, standard operating procedures, licensing requirements).
INI = Improve the existing Navigation Information (charts & hydrographic information) for the port.
IAN = Improve the existing short range Aids to Navigation (buoys and lights) in the port.
IEA = Improve the existing Electronic Aids to navigation (LORAN, GPS, GMDSS) in the port.
AIS = implement an Automatic Identification System for the port.
EAIS = implement an Enhances Automatic Identification System for the port.
VSC = improve the Vessel traffic Service Communications capabilities.
VSI = improve the Vessel traffic Service infrastructure (radars & cameras).

Analysis:

This port already has a VTS in place and working. The comments and tools described herein are made with this in mind. The participants believe that the following top five risk factors were not mitigated and described the tool that would correct

Waterway Complexity		EAIS
Volume of Chemicals	:	EAIS
Economic Impacts		EAIS
Volume of Petroleum		EAIS
Traffic Density		VTS

In short, the participants indicated that an addition of an EAIS to the port of Houston/Galveston would significantly reduce the risk of a casualty.

Scope of the port area under consideration: (The participants addressed the geographic bounds of the waterway **)**	
Port area	**From sea (include the Precautionary Area) to turning basin in Houston including major channels and main bodies that intersect; west to the Causeway Bridge and east to Rollover Pass.** •

Risk Factors	Risks	Mitigations
Fleet Composition		
% High Risk Deep Draft Cargo & Passenger Vessels Defined in terms of poor maintenance, high accidents, quality of crew	1. **Vessel crew** • **Language** – Helm understanding pilot's orders – ability to carry them out • **Limited local knowledge** • **Crew competency** and **training** 2. **Poorly maintained** vessel – no place to stop • Close passing of vessels…need vessel control 3. **Inaccurate reporting** of vessel condition 4. **Percent** high risk – approaching 30 percent; statistics show 23 percent (CG numbers) 5. **Barbers Cut** – (expanding – cruise ships going in) 6. No guidance at **Precautionary Area** 7. Percent of detention **–**CG **confirms 5%** by statistics	• **Crew Competency -** Pilot onboard at Precautionary Area mitigates risk…have local knowledge • **Port State Control program** keeps the high risk vessels from coming in. o CG does operational tests of crews. • Take advantage of stats and look at screening process • All pilot are state licensed with local knowledge
%High Risk Shallow Draft Cargo & Passenger Vessels *Drafts of 14 feet or less*	1. **Language** 2. Lack of **local knowledge** – Tow boats 3. Two categories of shallow draft vessels predominate the area: • Inland **towing** vessels/barges • Offshore supply vessels (**OSV**) ▪ Maintenance ▪ Lower Bay area 4. Ship handling characteristics are suspect 5. Commercial **F/V** – significant risk problem – predominantly shrimping • large impact with ferries – communications; • fishing in the channel restricts traffic • Crew competenc – lack of training maneuvering in traffic • Maintenance and standards of upkeep – must go out and pull off bottom, clean up oil spills • Outside the jetties during fishing seasons – not following rules of the road 6. Recreational – need to educate – 50 percent have problems • Competency • maintenance • Alcohol consumption	• Concerned about power to tonnage ratios •
Traffic Conditions		
Volume of Deep Draft Vessels	1. **Today** • Percent of ships at **max draft** coming into the harbor – 5 % at 40 foot; at 36 feet – still at about 5%. (argument that 30% is at max depth…pilots did not seem to agree)	•

Risk Factors	Risks	Mitigations
	• Chemical carriers – **dock congestion utitilization.** Unavailability of lay cock require more transits of the channel. More regs may require more transits for tank cleaning. 2. **Future** – will increase • **Offshore lightering** will continue and expand into the future – includes a multitude of trades • Cargo change from crude to finished product and refining industry ages • More **feeder barges and vessels** • More inter-modal moves • Availability of lay berths will become scarce • Ship transits increase at 3-4% per year	
Volume of Shallow Draft Vessels *Includes foreign fishing vessels*	1. **Today** • Barge width – 108 foot is widest • **Barge fleeting areas** – Rollover, government moorings (ICW), Carpenter's Bayou, Old River, Greens Bayou – **many barges way up in the harbor** • **No increase** on number of barges in last few years 2. **Future** – building more tugs an barges every day. • Ship transit – slow increase in numbers • Offshore business is cyclical	• Widen the channel • Establish a **barge lane** • Establish a **separate barge channel** • Large ships get free wharf-age while awaiting Stevedores • Some vessels are limited to **daylight** ops only
Volume of Fishing & Pleasure Craft *Domestic F/V and PC*	1. Today • **Fishing vessels –** risk factor reducing o Inshore - numbers have **reduced** from 5K to 1200 inshore F/V**. Number of licenses are reduced.** o Offshore…a slight **increase.** • Recreation boats – 7000 boat capacity in marinas – 7000 boats in Clear Lake area o 60 launch ramps 2. Future • **Recreation Boats** – trailer able boats will be increasing. Larger slips will attract larger rec boats. o Boats migrate from lake to waterway. o Bad and getting worse o Large boats limited by number of moorage slips	• State is buying out F/V. Remaining fleet is in good material condition • More training will help • Regulations passed to limit **age** of Jet ski operators and all boaters. • Born after 1 Sep 84 must be **licensed** by state to operate a vessel. o This must include **education**

Risk Factors	Risks	Mitigations
Traffic Density	High Density at following locations: 1. Between Lynchburg and Shell 2. Pelican Island out to buoy 11 3. Feed from Clear Lake comes in at Red Fish 4. Five mile/four mile pass 5. Precautionary Area offshore 6. Causeway Bridge 7. The Dike Area – rec boats stay to north side of dike 8. Can't get enough air time to make passing arrangements 9. Fishing boats fish in the channel	• Separate deep and shallow draft traffic – get the **tug and barge shelf** • Portion up to Red Fish is there - dredged • **Legislation** is in the making – extend dredging across the bay • Note: As dredging is developed, buoys will be moved equidistant from the center • Suggest: Add a **barge buoy line** in addition to the deep draft channel line • Reduce the amount of **voice** communications…**clutter** on the radio • Reduce the amount and **size of wakes** from the deep draft vessels • Create a **separation zone** (first step is regulated navigation area) • Get fishing boats out of the channel
Navigational Conditions		
Wind Conditions *Over 20 knots, problems for recreation boats; Over 25-30 knots causes problems for deep draft vessels*	1. Winds mostly from S and SE 2. 15 – 20 kts of wind pretty constant 3. Shallow draft vessels – inland towboats – greater than 50% of the time experience high wind 4. For deep draft, low percent of time for high wind. 5. ICW – three mile area – many turns – wind affects maneuvering 6. Empty tows – **whole open bay area** – offers no protection to winds **25 - 30 knots from north** – water is blown out, also, reducing depth of water. **Numerous ATON damaged by tows** 7. Combination of low water and high currents with north wind 8. **Hurricane conditions** – cruise vessels and other vessels are **evacuating** 9. All winds create a problem under the Causeway Bridge	•

Risk Factors	Risks	Mitigations
Visibility Conditions	1. **Fog** – Principally winter months – less than 5 percent of the time per year (250 to 600 hours – approx 2 days a month – channel closure based on fog) 2. Can Persist for a week or two – channel closed for, maybe 4-5 days. Fog sticks around for awhile once is comes. 3. fog can occur in portions in the waterway, not the complete waterway 4. **Heavy rain** storms last a short duration 5. Late fall – **smoke days -** unusual	•
Currents, Tides and Rivers	1. Significant current affect at sea end of **jetties**. 2. Cross Current at **ICW** and main channel 3. Turn from Texas City into the ICW – cross current 4. Cross channel current at **San Jacinto** intersection 5. Heavy rains will cause problem in upper turning basin – spring run off – all the bayous are the same 6. **Greens** Bayou – cross current after heavy rain 7. Extreme low tides – wind blows from the north…up to 2 feet below MLW. At this time, tides do not follow forecast 8. **Pelican Island** Bridge (Galveston) – low tide problem 9. **Roll Over Pass** – cross current	•
Ice	None	
Waterway Configuration		
Visibility Obstructions *Cannot see ATON or other ships*	1. **Bolivar Roads Anchorage** – ship at anchor can block the outer bar range 2. **Light pollution upper Galveston Bay** – above Bayport – light from Barbers Cut 3. **Light pollution from Lynchburg** - background 4. **Texas** City – second inbound range – background lites from Texas City 5. Entrance Channel ranges are barely adequate – outside the jetties (from sea buoy) 6. Causeway Bridge for the tow boaters due to lay of the land and the bridge in the way – cannot see traffic 7. Shallow draft cannot see ranges around deep draft vessels in the ship channel 8. Tug spot lights are blinding people 9. Dim running lights 10. Deep draft vessels cannot see distance under bow – 800 – 1000 feet	• **Ranges** behind anchorage – raise them above the level of the ships • Entrance **ranges** – need a super range • Insure that facility lights are shielded from blinding the operators

Risk Factors	Risks	Mitigations
Passing Arrangements	1. **Carbide Canal** – narrow with blind corner 2. Upper channel – **Greens Bayou** on up – CG works with pilots to control traffic due to narrow waterway. Berthed vessels restrict both meeting and overtaking 3. Turning out of ICW into Houston Ship Channel – Dayboards moved out to avoid being hit 4. **ICW to Bolivar** – narrow channel combined with wind and current cause crabbing 5. **Baytown** – terminal – sometimes used for overtaking and gets narrow – will have dredges in that channel in the future – for another 3 years 6. Main channel at **Lynchburg** is narrow	• Group consensus is that channel is narrow but not a problem due to mitigation measures already taken • East bound and west bound tows are not to meet at the ICW and main ship channel intersection
Channel and Bottom	1. Predominantly **sand and mud** 2. Some **rock** piles 3. Can hit the jetties **4. Red Fish shoals** 5. **Pipeline** and anchoring areas throughout the entire bay 6. Shoaling areas – vessels caught by shoals – Bayport intersection and by buoy 10-12 7. Entrance to Galveston Harbor **8. Texas City Dike** 9. **Baytown tunnel to Exxon Dock**	• Group consensus is that bottom is relatively forgiving

Risk Factors	Risks	Mitigations

Waterway Complexity	All types of vessels, deep draft, fishing, pleasure, fishing are almost continuously at risk of collision conditions at the following locations:9
	1. Lynchburg – ferry route
	2. Entrance channel
	3. Carpenter's Bayou
	4. Bayport
	5. San Jancinto River
	6. Passing vessels pulling lightly moored vessels off the dock
	7. VTS is limited by air time (communications)
		• Incidents have decreased in the past years – 1999 had a total of 200 incidents. (229,000 movements per year)
		• 79 groundings
		• 10 collisions
		• 6 Allisions
		• About **one** grounding, collision, and allision **every three days**
		• A surveillance system has been installed (**VTS**)
		• Coordination at the **local** level – also need more resources to act on coordinated efforts
		• Add more **mandatory controls** at high density areas/intersections
		• Need information
		  • Calculated ETA to for meeting vessels
		  • Calculate who is going to meet when and what impact is
		  • AIS would give clear information on converging ships
		• Waterway has been widened; PORTS installed and used
		• **Reduce** the amount of **information** being passed over the **radio**
		• Look at **voiceless comms** of AIS
		• Have agencies look at improving the marine transportation system in coordination with **other agencies**
		• Need to use 'defensive driving' techniques

<u>Short Term Consequences</u>		

Number of People on Waterway	1. **Cruise** ships in/out Barbers Cut; - future off Bayport – Galveston to get cruise ship in September. This will be expanding – three new ships.
	2. **Ferry** ops
	  o Upper Bay – small ones
	  o Galveston to Bolivar – large ones
	  o Expand ferry service
	  o Numbers to double
	3. **Party boats** (up to 75 persons) out of Galveston headed off the coast
	4. **Tour boat** runs out of turning basin
	5. **Gambling ships** coming to Galveston
		• Improve vessel crew **training** – crowd control (ferry)
		• Provide response **resources**
		• Provide **coordination** effort
		• **Contingency** planning
		• Reduce the **exposure** time on the waterway…put berth closer to the entrance channel

Risk Factors	Risks	Mitigations
Volume of Petroleum Cargoes	1. Two thirds of cargo tonnage is petroleum 2. Most in upper bay…50 some odd miles o Texas City o Baytown o Bayport o Landell o Houston o Shell o	• Response quickly available for limited clean up o

Volume of Hazardous Chemical Cargoes	1. Same as Petrol Cargoes
	2. Add Barbers Cut and City Docks as lay berths for hazardous materials carriers
	3. Occasionally Galveston Docks as lay berth
	4. Add Brady Island
	5. Use of LNG may be going up
	6. ID of containerized HAZARDOUS MATERIALS cargo not readily available
		• Reduce the volume of transits and causal probabilities
		  • Provide a closer lay berth for vessels awaiting dock time
		• Look at assets in Texas City, Galveston area.
		• Consider public education
		• Insure response assets and evacuation plans are maintained and ready to go
		  • Training of people
		  • Exercised regularly
		  • There is a reasonable level of response equipment
		• Consider double hull vessels to transport the HAZMAT – most chemical tankers have double hulls and bottoms
		• Work with other agencies to communicate to and educate the public
		• Isolate facilities

Long-Term Consequences	o	o

Economic Impacts	1. Time from casualty to significant economic impact – in terms of days – 3-4 days
	2. There are some just in time cargo transfers
	3. Texas City runs on two day supply
	4. Beaches are close by and used by tourists
	5. Refineries must have product – cost to stop and restart is high
	o
		• Install a LOOP (offshore with pipeline)
		• Discharge cargoes closer to entrance (in Galveston)
		• Put a larger reserve in storage – a stockpile
		• Establish alternate transportation modes (trucks and railroads) – There is a good infrastructure
		  • Infrastructure cannot handle the volume
		  • Transportation charges will increase (rail and truck charges)
		• Enhanced capabilities to navigate and **meet traffic** safely in the fog (areas of fog) – increase efficiency
		o

Environmental Impacts	1. Galveston Bay is second most productive estuary in U.S. 2. Mud flats off Bolivar	• Contingency Plans – exercise the plan with people and equipment – regularly

Risk Factors	Risks	Mitigations
	3. Pelican Island – nesting ground 4. Beaches and beach front – both sides o	• Nationally 12 ports a year have their contingency plans exercised • OPA 90 regs require regular plan exercise • Responding organizations have to meet certain standards • This area has a lot of response equipment o
Health and Safety Impacts *Includes dependent community*	1. Once above Barbers Cut…many people living around the water area – landlocked 2. Drinking water comes from Lake Houston, well north of the community and not affected by any type of spill 3. HL&P has power plant off Dickinson Bay – using cooling water 4. Plants along waterway rely on cooling	